

CLAIMS

What is claimed is:

1. A head-up display containing a plurality of elements optically coupled along an optical path, the display comprising:
 - an image source that emits a visible light for generating an image;
 - 5 a means for diffusing light that receives the visible light from the laser scanner to project the transmitted generated image thereon; and
 - a substantially transparent element for producing a virtual image from the generated image from the means for diffusing light.

2. The display of claim 1, wherein the means for diffusing light provides gain for the image thereon.

3. The display of claim 1, wherein the substantially transparent element is a
5 holographic element that provides magnification for the image thereon.

4. The display of claim 1, wherein the substantially transparent element is a
holographic element configured to be disposed on a windshield of a vehicle, and wherein
the means for diffusing light is configured in the optical path to project an image from the
10 laser scanner to the holographic element which operates to reflect the image to within the
vehicle in a way to provide a virtual image at a predetermined distance ahead of the
windshield.

5. The display of claim 4, wherein the means for diffusing light a driver's viewing
15 angle are related by the Bragg condition for the holographic element.

6. The display of claim 1, wherein the substantially transparent element is a
holographic element that incorporates the means for diffusing light and is configured to
be located below a windshield of a vehicle in the optical path to project an image from
20 the laser scanner to the windshield which operates to reflect the image to within the
vehicle in a way to provide a virtual image at a predetermined distance ahead of the
windshield.

7. The display of claim 1, wherein the substantially transparent element is a
25 holographic element that incorporates the means for diffusing light and is configured to
be disposed on a surface of a windshield of a vehicle, and wherein the holographic
element provides reflection at the frequency of the emitted light of the laser scanner to
provide a reflected image to an interior of the vehicle.

8. The display of claim 1, further comprising optical elements disposed in the optical path after the means for diffusing light, wherein an exit cone of light from the means for diffusing light is substantially captured by an acceptance angle of the optical elements.

5 9. The display of claim 1, wherein the laser scanner is configured to pre-distort the generated image to compensate for distortions in the optical path.

10. The display of claim 1, wherein the means for diffusing light is configured in a non-flat shape to compensate for aberrations in the optical path.

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11. A head-up display for a vehicle containing a plurality of elements optically coupled along an optical path, the display comprising:

a laser scanner that emits a raster scan of visible light to generate an image;

a means for diffusing light placed in an intermediate plane of the optical path that

5 receives the visible light from the laser scanner to project and apply gain to the image generated thereon; and

a holographic element for producing a virtual image from the generated image,

the head-up display being operable to project the image to a driver within the vehicle using a windshield of a vehicle in a way to provide a virtual image at a

10 predetermined distance ahead of the windshield.

12. The display of claim 11, wherein the holographic element is configured to be disposed on a windshield of a vehicle, the holographic element configured to reflect light at the frequency of the light from the laser scanner, and wherein the means for diffusing light is configured in the optical path to project an image from the laser scanner to the
5 holographic element which operates to reflect the image to within the vehicle in a way to provide a virtual image at a predetermined distance ahead of the windshield.

13. The display of claim 12, wherein the holographic element provides magnification for the image thereon so as to reduce a length of the optical path.

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14. The display of claim 11, wherein the holographic element incorporates the means for diffusing light and is configured to be located below a windshield of a vehicle in the optical path to magnify and project an image from the laser scanner to the windshield which operates to reflect the image to within the vehicle in a way to provide a virtual
15 image at a predetermined distance ahead of the windshield.

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15. The display of claim 11, wherein the holographic element incorporates the means for diffusing light and is configured to be disposed on a surface of a windshield of a vehicle, and wherein the holographic element provides reflection at the frequency of the
20 emitted light of the laser scanner to provide a reflected image to an interior of the vehicle while transmitting light of other frequencies therethrough.

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16. The display of claim 11, further comprising optical elements disposed in the optical path after the means for diffusing light, wherein an exit cone of light from the
25 means for diffusing light is substantially captured by an acceptance angle of the optical elements that follow in the optical path.

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17. The display of claim 11, wherein the laser scanner is configured to pre-distort the transmitted image to compensate for distortions caused throughout the optical path.

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18. A head-up display containing a plurality of elements optically coupled along an optical path for operation using a windshield of a vehicle, the display comprising:

a laser scanner that emits a raster scan of visible light to generate an image;

a means for diffusing light placed in an intermediate plane of the optical path that

5 receives the visible light from the laser scanner to project and apply an adjustable gain to the transmitted generated image thereon; and

a holographic element placed between the laser scanner and a driver of the vehicle,

the holographic element receiving and magnifying the image to produce a virtual image therefrom,

10 the head-up display being operable to project the image to a driver within the vehicle using a windshield of a vehicle in a way to provide a virtual image at a predetermined distance ahead of the windshield.

19. The display of claim 18, wherein the holographic element is configured to be disposed on a windshield of a vehicle, the holographic element configured to reflect light at the frequency of the light from the scanner, and wherein the means for diffusing light is configured in the optical path to project an image from the laser scanner to the
5 holographic element which operates to reflect the image to within the vehicle in a way to provide a virtual image at a predetermined distance ahead of the windshield.

20. The display of claim 18, wherein the holographic element incorporates the means for diffusing light and is configured to be located below a windshield of a vehicle in the
10 optical path to magnify and project an image from the laser scanner to the windshield which operates to reflect the image to within the vehicle in a way to provide a virtual image at a predetermined distance ahead of the windshield.